USING AUTOMATION AND PROCESS IMPROVEMENTS TO ELIMINATE MANUAL STEPS AND RELATED ERRORS

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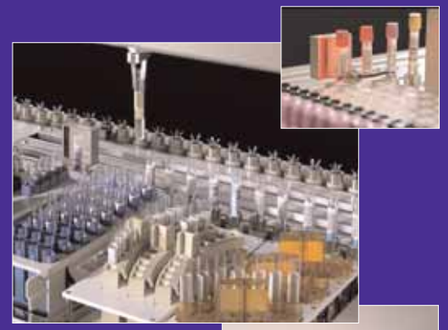

Summary

At a 427-bed community hospital, a clinical laboratory implemented both lab automation and process improvements to minimize opportunities for errors that could harm patients. The two initiatives were phases of the same project. The lab's automation vendor (Beckman Coulter, Inc. of Fullerton, California) recommended that the lab modify and streamline its processes in concert with automation, thereby eliminating inefficient or faulty processes.

The initiatives had a cumulative positive effect on error reduction. They not only eliminated numerous error-prone tasks that are ordinarily performed by medical technologists, but also eased stressful work conditions. In addition, they reduced turnaround time (TAT) for test results, addressing an additional cause of medical errors: delayed diagnosis/treatment.

Challenge

The clinical laboratory is the predominant source of information physicians rely on for important diagnosis and treatment decisions, so it is crucial that labs minimize errors in results and results reporting. Most lab errors result from manual steps performed by technologists and other lab professionals. There are several reasons for this. Humans are fallible under the best of circumstances, and work stress can exacerbate that fallibility. Human variability is another source of potential errors. Even dedicated and experienced technologists perform with some variability. Variability is a much bigger problem when performance differences between individuals and groups of individuals (for example, work shifts, or permanent staff vs. temporary staff) are considered.

Some errors can be eliminated by redesigning processes to reduce the number of human-performed steps and create a more efficient workflow. Once processes have been optimized, however, further error reductions can only by achieved by "reassigning" tasks to automated instruments, which are known to perform these tests more reliably than humans and do not fatigue. In addition, automated instruments perform without variability, which is also the key to the efficiency gains they produce.

Objective

- Streamline processes as part of an integrated lab automation project to reduce errors and TAT. Place particular focus on the ordering and sample collection processes, to reduce errors that occur before samples reach the lab.
- Automate all three phases of testing to eliminate the maximum number of human steps possible and further speed up TAT. (Automating the pre-analytic phase alone produces major gains in patient safety, because the pre-analytic phase includes the highest proportion of error-prone manual steps in the lab, including such critical patient safety-related tasks as properly matching patient and sample.)
- Autoverify and automatically report normal test results according to user-defined criteria, a capability of the automation system's innovative data management software in conjunction with the laboratory information system (LIS). Autoverification and automatic reporting reduce errors and work stress by turning over to the software a high volume of routine work previously performed by technologists. This in turn frees technologists to focus more attention and critical thinking skills on tests that must be performed or validated manually, which reduces errors related to these tasks.

Facility

Elmhurst Memorial Hospital (EMH) was founded in 1926 as the first hospital in DuPage County, Illinois. The hospital now encompasses 427 licensed beds and a staff of more than 2,800 employees and 550 physicians.

Interventions

1) Process redesign. This phase of the project was assisted by consultants from Beckman Coulter.

2) Integrated lab automation.

Automation components include:

- Power Processor sample-processing system for automation of pre-analytic processes. EMH's Power Processor includes an integrated centrifugation unit, decapper, aliquotter, and hematology outlet.
- Two SYNCHRON LX20 Chemistry Analyzers.
- UniCel Dxl 800 Immunoassay System.
- DL2000 data management software.
- Track-based system to connect Power Processor to the LX20s and Dxl.
- Refrigerated stockyard (pending – scheduled to be added in May 2005).

Automated functions include:

- Sample log-in and sorting, utilizing barcode technology.
- Centrifugation.
- Tube decapping.
- Aliquotting.
- Repeat testing (including sample retrieval for the test).
- Dilution.
- Add-on testing.
- Automatic validation of normal test results (see above).
- Reporting of results to patient's chart through the laboratory information system.

Results

- Reduction of manual steps. Together, process streamlining and automation reduced testing steps at EMH from 15 to four. Most of the eliminated steps involved error risk related to specimen handling.
- Autoverification. At EMH, 80-85 % of more than 1 million chemistry/hematology results are autoverified.
- TAT. Pre-automation, EMH met its goal of getting in-house test results to physicians for morning rounds 55% of the time. Post-automation, that goal is met 96% of the time. Pre-automation, the lab delivered timely troponin and myoglobin results to ED physicians 72% of the time. Post-automation, the goal is met 90% of the time. Pre-automation, the lab met its basic metabolic panel TAT goal of 35 minutes 58% of the time. Post-automation, the goal is met 94% of the time.
- Error reduction in ordering process. The following are examples of improvements from February 2004 to October 2004. These improvements can be credited to the process analysis aspect of the automation project and were applied during the project's process redesign phase:
  - On individual chart orders, duplicate orders decreased from 31% to 1%. Duplicate orders can lead to unnecessary multiple sample draws, which are a discomfort to patients and, in the case of blood draws, can lead to anemia in pediatric and geriatric patients. Duplicate orders also cause confusion, which can slow TAT, and are a potential source of errors.
  - Orders signed by MDs increased from 86% to 100%. Hospital accrediting bodies require that all test orders be signed by MDs. Unsigned orders can slow TAT because the order cannot be processed until a signature is obtained. In addition, laboratory resources must often be deployed to obtain that signature, another factor that negatively affects TAT.
  - Orders requiring clarification decreased from 21% to 1%. Orders requiring clarification slow TAT while clarification is being obtained. They are a potential source of errors, as well.
- Fewer corrected reports. Corrected reports are direct evidence of errors that occur in the lab – when an error is caught and corrected, a corrected report is issued. Before EMH automated, the percentage of corrected reports was 0.13. Currently, the percentage is 0.05. Reporting errors such as mislabeling of an aliquot tube or incorrect validation of a result, which can have a negative impact on patient safety, have been substantially reduced by automation.
- Reduced work stress. Although it is an indirect indicator, EMH's low staff turnover rate suggests that automation has significantly reduced work stress. EMH's turnover rate is less than 10%, compared to the 17% rate in EMH's region. Reduced stress makes it possible for technologists to do higher quality, more focused work. Lower turnover means that EMH retains more of its experienced technologists, another important factor in maintaining the quality of staff performance and reducing errors.

Conclusions

Errors and error potential in the test ordering process can be eliminated by analyzing processes, standardizing processes, minimizing variability, and eliminating manual steps. These same measures can, and should, be applied to the three phases of lab testing. Furthermore, as many of the remaining manual steps as possible should be automated. Only by automating can labs eliminate errors caused by human fallibility and variability.

In other words, while streamlining processes helps reduce errors in the lab, it is really only a half measure. The most comprehensive – and efficient – approach to reducing lab-related errors is to streamline processes and automate as part of a single project, with the process streamlining as a preparatory stage for the automation.

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